



Perceived Partner Responsiveness Mediates the Association Between Sexual and Marital Satisfaction: A Daily Diary Study in Newlywed Couples

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Abstract Sexuality is an integral part of intimate relationships, yet surprisingly little is known about how and for whom sexuality matters. The present research investigated the interplay of sexual and non-sexual factors that contribute to relationship satisfaction. Specifically, we tested the hypothesis that the association between sexual satisfaction and marital satisfaction is mediated by a non-sexual factor—namely, perceived partner responsiveness (PPR). Additionally, we tested the role of gender as a possible moderator of this mediated association. Thirty-four newlywed couples completed diaries with each spouse reporting their sexual satisfaction, marital satisfaction, and PPR every day for 30 days. We tested our predictions at both the person level (i.e., the mean level across 30 days) and the daily level. At the person level, we found that sexual satisfaction and PPR separately predicted marital satisfaction. Moreover, the effect of sexual satisfaction on marital satisfaction was partially mediated by PPR. No gender differences emerged at this level. At the daily level, we found similar support for partial mediation. However, at this level, gender did serve as a moderator. The stronger

mediation found for women was driven by a stronger association between sexual satisfaction and PPR for women than for men. This study joins a growing literature highlighting the role of PPR in dyadic relationships.

Keywords Perceived partner responsiveness · Sexual satisfaction · Marital satisfaction · Daily diaries

Introduction

Sexual satisfaction is an affective response arising from the subjective evaluation of the positive and negative aspects of one's sexual relationship (Lawrance & Byers, 1995). As such, it is related to, yet distinct from, momentary sexual pleasure (e.g., orgasm). It is also related to, yet distinct from, broader *relationship satisfaction*—i.e., the affective response arising from the subjective evaluation of the positive and negative aspects of one's relationship, overall.

Both cross-sectional studies (e.g., Butzer & Campbell, 2008; Cupach & Comstock, 1990; Dundon & Rellini, 2010; Litzinger & Gordon, 2005) and longitudinal ones (e.g., Byers, 2005; Fisher & McNulty, 2008; Sprecher, 2002; Yeh, Lorenz, Wickrama, Conger, & Elder, 2006) have documented an association between sexual aspects of relationships and the stability and satisfaction of these relationships. Yet, as prominent writers on the topic (e.g., Byers, 2005; Christopher & Sprecher, 2000; Rehman, Fallis, & Byers, 2013) have noted, the direction of this association remains unclear: it is possible that sexual satisfaction influences relational satisfaction, but alternative causal models (e.g., that the causation is reversed, that it is bidirectional, or that a third variable causes both) are all plausible.

One prominent account of the association was offered by the Interpersonal Exchange Model of Sexual Satisfaction (IEMSS; Lawrance & Byers, 1995; see also Sprecher, 1998). This model

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uses a social exchange framework to propose that sexual satisfaction is influenced by four different components, one of which being the quality of the nonsexual aspects of the relationship. Lawrence and Byers offered support for the model, demonstrating that relational satisfaction contributed uniquely to subsequent sexual satisfaction, though interestingly, the reverse was also true in their data. In contrast, in a multi-wave study of dating couples, Sprecher (2002) found no evidence that relationship satisfaction predicts subsequent changes in sexual satisfaction (or vice versa). Byers (2005) reached similar conclusions using a two-wave sample of individuals in long-term relationships.

The possibility of bidirectional causality has been demonstrated in a 2-year longitudinal study (Henderson-King & Veroff, 1994) of newly married couples. However, the analytic approach of that study has been criticized and its results called into question (Byers, 2005). Other studies have posited reverse causality. For example, Yeh et al. (2006) found that earlier sexual satisfaction was predictive of changes in both marital quality and marital instability over five time periods; the reverse was not found. Finally, a shared (third variable) causal model was presented by Cupach and Comstock (1990) who suggested that communication skill predicts both sexual and relationship satisfaction, as well as concurrent changes in the two (cf. Byers, 2005).

These conflicting results have led some researchers to note that “the relationship between sex and affection [...seems...] so reciprocal that the question of causation appears futile” (Henderson-King & Veroff, 1994, p. 521). On the other hand, as Sprecher (2002) noted, it may be that the reciprocal influence of sex and affection happens on a quicker time scale; this would imply that data of a more intensive nature are necessary to help disentangle this complex association. Byers (2005) made a similar point, noting that the “very small increments or decrements in relationship satisfaction [may] cause equally small changes in relationship satisfaction (or vice versa) over so short a time period that relationship satisfaction and sexual satisfaction change concurrently” (p. 117). Inspired by these suggestions, the current study tried to address the gap in our knowledge about how sexuality affects relationship satisfaction in daily life, by utilizing a daily diary framework to examine one possible association between the two constructs.

In the present study, we used a dyadic daily diary design to test a theoretical model of the day-to-day association between sexual and relationship satisfaction. The model posits that sexuality (and specifically, the affective tone of the sexual aspect of one's relationship) will engender a perception of greater partner responsiveness (Clark, Graham, Williams, & Lemay, 2008) and through it, will be tied to greater relationship satisfaction. This model is premised on the responsiveness concept (e.g., Reis & Clark, 2013) and on an attachment perspective. As leading attachment theorists have noted, “...humans possess basic needs that are naturally satisfied by social relationships, such as the needs for emotional support, care, and sexual gratification [...] A relationship is satisfying to the extent that it

meets basic needs. At any age, attachment quality turns in large part on the answer to the question ‘Can I trust my partner to be available and responsive to my needs?’” (Hazan & Shaver, 1994, pp. 10–13).

The novel moderated mediation model we are testing (see Fig. 1) draws on both a responsiveness framework (Reis & Clark, 2013) and an attachment perspective (Hazan & Shaver, 1994). It suggests that sexual satisfaction will lead to the perception that one's partner is responsive, and through it, will be tied to greater relationship satisfaction. As we note below, it also predicts that this mediation will be stronger for women than for men. This model has never been previously tested, particularly with intensive data from the daily lives of couples.

The Proposed Mediator: Perceived Partner Responsiveness

Perceived partner responsiveness (PPR) has been proposed as a central organizing principle for relationship science (Reis, 2007; Reis & Clark, 2013; Reis, Clark, & Holmes, 2004). PPR involves the sense that one's partner is caring, understanding, and validating. To date, research on PPR and on related constructs such as support has largely focused on its associations with stress, affect, and intimacy (e.g., Debrot, Cook, Perrez, & Horn, 2012; Gable, Reis, Impett, & Asher, 2004; Gleason, Iida, Bolger, & Shrout, 2003; Iida, Seidman, Shrout, Fujita, & Bolger, 2008; Rafaeli, Cranford, Green, Shrout, & Bolger, 2008; Story & Repetti, 2006). For example, using daily diaries, Rafaeli et al. (2008) found that individuals' perceptions of receiving support (an aspect of PPR) primarily influence positive relationship feelings. Of relevance to the current study, PPR has been found to play a mediating role in the association between concrete responsive acts (e.g., a supportive text message) and both recipients' and providers' feelings of intimacy (Debrot et al., 2012). In addition, PPR has been associated with both sexual satisfaction (Reis et al., 2004) and sexual desire (Birnbaum & Reis, 2012), though it has not yet been examined as a mediator between these sexual constructs and other relationship outcomes.

PPR can be assessed at a stable general level, representing a person's overall sense of trust in a relationship, or at a more transient level, representing the felt sense of responsiveness in a

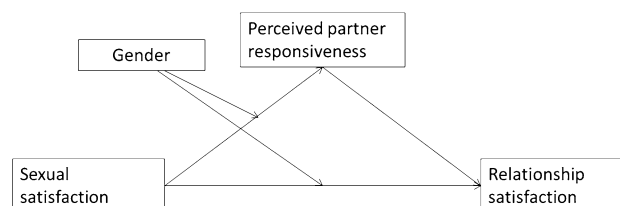


Fig. 1 Proposed moderated mediation model: PPR as a mediator of the association between sexual and relationship satisfaction, with gender as a moderator of the mediation. *Note* This is a generic representation of the (actor-only) model used in both the person- and day-level analyses; the actual models included partner effects as well as various covariates described in the text

given moment or day (Reis et al., 2004). In the former sense, the PPR index serves as a general indicator of the relationship. In the latter sense, it is reactive to events, both positive and negative, within the relationship. In the present study, we examine the process by which sexual satisfaction is tied to relationship satisfaction, presumably through its association with both stable and transient PPR. Thus, we will test both the person-level question (i.e., are sexually satisfied individuals more maritally satisfied because they perceive their partners to be responsive, on average) and the day-level question (i.e., is the association between sexual satisfaction and marital satisfaction on a given day mediated by an increased perception of partner responsiveness, longer-standing histories of satisfaction notwithstanding).

The Proposed Moderator: Gender

The role of sexuality vis-à-vis relationship satisfaction is often considered from a gender perspective (e.g., Baumeister & Vohs, 2004; Karney & Bardbury, 1995; Petersen & Hyde, 2010). For example, women, more than men, experience sexual intercourse as a reflection of relationship quality and view sexuality as more emotional/interpersonal, whereas men tend to focus more on the fulfillment of sexual needs (Birnbaum & Laser-Brandt, 2002; Birnbaum, Reis, Mikulincer, Gillath, & Orpaz, 2006). Moreover, there is preliminary evidence that gender moderates the association between sexual activity and relationship feelings and behaviors. For example, in a daily diary study, Birnbaum et al. (2006) found that for women (but not men), positive feelings reported during sexual activity were associated with next-day reports of more relationship-enhancing behaviors, less relationship-damaging behaviors, and higher relationship quality.

On the basis of these findings, we predicted that sexual satisfaction will serve as a stronger predictor of both PPR and marital satisfaction among women than among men. We note, however, that some studies fail to find such gender differences (e.g., in the positive association between sexual satisfaction and marital quality (Stanik & Bryant, 2012) or in the inverse association between dissatisfaction with the frequency of sexual activity and relationship satisfaction (Smith et al., 2011).

Current Study

As the literature reviewed above suggests, PPR may be one mechanism for the association between sexual and marital satisfaction. If that is the case, the association between sexual and relational satisfaction would be mediated by changes in the perception that one's spouse is attentive, caring, and responsive. This is consistent with the view that sexual satisfaction can foster intimacy, feelings of connectedness, and security (Hazan & Shaver, 1994).

Studies of sexual and relational satisfaction have usually relied on cross-sectional designs, and rarely recognized the potential reciprocal effects that may take place within dyadic relationships.

Such studies allow for a global prediction but eschew more detailed analyses of process. To date, there have been no studies that examined the association between sexual satisfaction and marital satisfaction on both the trait (person) and state (day) levels while also including a theoretically based evaluation of a variable that may help explain their association.

The current investigation sets out to do so using dyadic daily diary methods. With these methods, both person-level and day-level processes are examined. Additionally, though our predictions center on the link between respondents' sexual satisfaction, perceived responsiveness, and marital satisfaction, our use of dyadic diary data allows us to examine both individuals within the couples simultaneously, and employ the strongly recommended Actor Partner Interdependence Model in which both (hypothesized) actor effects and (exploratory) partner effects are examined (Kenny, Kashy, & Cook, 2006).

This study focuses on young couples in the early stage of their marital relationship. Newlyweds are a particularly appropriate sample to use in addressing this issue, as they tend to experience rapid declines in sexual frequency (e.g., Call, Sprecher, & Schwartz, 1995), which can be accompanied by declines in sexual satisfaction (Liu, 2003; Sprecher, 2002). Thus, this study will examine fluctuations in sexual satisfaction during a stage in the relationship in which such fluctuations are particularly likely.

Method

Participants

Participants were recruited through the use of marriage licenses filed in Monroe County, Indiana. Couples married within the last year were sent letters inviting them to participate in the study in exchange for \$1 for each completed day, and an additional \$10 at the end of the study (i.e., up to a total of \$40); those who expressed interest were screened over the telephone for eligibility. Only couples who had been married for less than a year, for whom this was their first marriage, who did not have children, who spoke English, and who did not have immediate plans to leave Indiana were eligible to participate; in addition, they had to be between 18 and 40 years of age.

Participants were 34 heterosexual couples; the partners in each couple knew each other for 5.4 years on average ($SD = 3.38$, range, 1–14 years). Twenty (59 %) of the couples had moved in together prior to being engaged, and had been cohabiting for 3.1 years on average ($SD = 1.87$, range, 1–7). Ten (29 %) of the couples had moved in the following engagement but before getting married, and had been cohabiting for 1.6 years on average ($SD = 1.26$, range, 1–5 years). Finally, four couples (12 %) moved in after they got married; this group was married 0.8 years on average ($SD = 0.50$, range, 0–1).

Men's mean age was 25.8 ($SD = 3.0$) and women's mean age was 25.4 ($SD = 3.4$). The majority of husbands (91 %) and wives

(94 %) had attended college, technical school, or university, but most (71 % of husbands and 59 % of wives) were no longer in university. Most husbands (82 %) and wives (66 %) indicated that they were employed full time. Twelve percent of husbands and 25 % of wives were working part-time, and 6 % of husbands and 9 % of wives were unemployed. Sixty-six participants (97.1 %) were Caucasian, one (1.5 %) was Hispanic, and one (1.5 %) described himself as “other.”

Diary Procedure

After completion of background questionnaires (not used in the present study, but reported elsewhere; Lykins, Janssen, Newhouse, Heiman, & Rafaeli 2012), couples were provided with password-protected handheld devices (TREO smartphones) and were given instructions on how to use the smartphone to complete the daily diaries. For a period of 30 days, the spouses completed the diary every evening, within a predetermined time interval. To address issues of privacy, we asked the participants to complete the questions alone, separate from their spouse. It was explained that once they submitted the diary for that day, their responses would be automatically transmitted to an Indiana University server and deleted from their smartphone. Answering the questions took approximately 10–15 min.

Daily Diary Questions

The daily diary questionnaire included a series of questions about affect, perception of partner's affect, PPR, relationship conflicts, daily activities and time spent together, relationship satisfaction and intimacy, sexual activities, sexual desire/arousal, and sexual satisfaction. Described below are the questions relevant for the present study.

Sexual Satisfaction

Participants were asked to rate how satisfied they were with their sexual relationship with their partner each day (regardless of whether they had engaged in sexual activity with their spouse) using one item (*How happy were you today with your sexual relationship with your spouse*) rated on a 7-point Likert scale (ranging from *extremely unhappy* to *perfect*). As sexual satisfaction was assessed using a single item, we followed the procedure used by Howland and Rafaeli (2010) to estimate the amount of reliable between-subject variance in this item by conducting a one-way ANOVA with person as the independent factor and daily sexual satisfaction as the dependent variable; 50.4 % of variance was due to person ($F[34, 954] = 28.55, p < .001$).

Marital Satisfaction

Participants used the same 7-point Likert scale (ranging from *extremely unhappy* to *perfect*) to rate how satisfied they were in

their relationship with their partner each day using a single item (*All things considered, how happy were you today with your overall relationship with your spouse*), adapted from the Dyadic Adjustment Scale (Spanier, 1976). A one-way ANOVA showed that 48.5 % of variance was due to person ($F[34, 971] = 26.90, p < .001$).

Perceived Partner Responsiveness (PPR)

Participants were asked to rate three items on a 7-point Likert scale ranging from 1 (*not at all*) to 7 (*very much*). The items inquired to what extent they felt today that “my partner *understood me*,” “...expressed liking and encouragement for me,” and “...valued my abilities and opinions.” The items were adapted from Reis (2003); though Reis's full 18-item scale has never been published, it has been used by several authors (e.g., Gable, Gosnell, Maisel, & Strachman, 2012), as a measure designed to assess how understood, validated, and cared for individuals feel when interacting with their intimate partners. The full scale includes items such as “My partner really listens to me.” This scale has been reported to have excellent reliability ($\alpha = .97$ in the Gable et al. study). We calculated the between- and within-subject reliabilities using procedures outlined in Cranford et al. (2006). For a given measure, the between-subject reliability coefficient is the expected between-subject reliability estimate for a single typical day. The within-subject reliability coefficient is the expected within-subject reliability of change within individuals over the 30 days of diary entries. The between- and within-subject reliabilities of PPR were .90 and .86, respectively.

Results

Data Analysis

Our data were hierarchically nested: days within individuals, and individuals within couples. To account for the non-independence of day-level data, and to prevent inflation of the effects (Krull & MacKinnon, 2001), we used the SAS PROC MIXED procedure for multilevel modeling, with Level 1 as the day level and Level 2 as the individual. Day-level predictors were centered at the person-means to make interpretation of intercepts clearer, to separate Level 1 and Level 2 effects, and to allow testing of interaction effects (see Zhang, Zyphur, & Preacher, 2009). Whenever possible, we used a lag-1 auto-regressive structure across the daily errors. When this was not possible, we used compound symmetry as the error structure.

We tested the hypothesis that the association between marital and sexual satisfaction is mediated by PPR. Following the recommendations of Preacher and Hayes (2004), mediation was examined in a series of three multilevel models. The first model tested the association between the predictor (individuals' sexual satisfaction) and the outcome (individuals' marital satisfaction);

the second model tested the associations between the predictor and the mediator (individuals' PPR); finally, the full-mediated model regressed the outcome (marital satisfaction) on the mediator and the predictor entered concurrently. To establish mediation with this approach, the predictor must be associated with the mediator, the mediator must be associated with the outcome (while controlling for the predictor), and the association of the predictor and the outcome must be reduced once the mediator is entered. We used the Sobel test to assess the significance of the mediation (Preacher & Hayes, 2004).

Notably, because indirect effects have non-normal distributions even if the errors are normally distributed, the Sobel test has been criticized as being biased (Shrout & Bolger, 2002). Thus, as an additional approach, we used MacKinnon, Lockwood, and Williams' (2004) Monte Carlo method as suggested by Bauer, Preacher, and Gill (2006) for assessing the significance of the indirect effects in the day-level data; similarly, we used bootstrapping as suggested by Ledermann, Macho, and Kenny (2011) for assessing the significance of the indirect effects in the dyadic person-level data. In both methods, we used confidence intervals of the indirect effects to determine statistical significance. Importantly, we examined the possibility that gender moderates the mediated association, using Muller, Judd, and Yzerbyt's (2005) guidelines for examining moderated mediation.

As covariates, we entered into the analyses (1) the lagged mean-centered outcome score (i.e., the previous day's outcome variable, entered as a deviation from the mean) and (2) the person's mean outcome score (averaged across the entire diary period). Thus, our outcome becomes a residualized change score. For example, in the first model, predicting daily marital satisfaction from sexual satisfaction, we entered yesterday's marital satisfaction into the model, along with the individual's mean level of marital satisfaction. Including lagged marital satisfaction means that whatever sexual satisfaction effect we find, would not include variance that is due to yesterday's satisfaction and its effects on sexual satisfaction (or directly on today's marital satisfaction). We also entered (3) the person's mean score of the predictors (in the same example, this meant entering an individual's mean level of sexual satisfaction). Including the person-mean variables allows estimation of both person-level and day-level effects (Bolger & Laurenceau, 2013). Disentangling the day-level and person-level effects also allows us to rule out static spurious "third variables" as alternative explanations.

The fact that our data were provided by couples generated an additional aspect of non-independence to consider. To address this, our analyses utilized APIM (Kenny et al., 2006). APIM is a dyadic data analytic approach that simultaneously estimates *actor effects* (the effects of the actor's independent variable scores; e.g., their own sexual satisfaction) on their own dependent variable score (e.g., their own relationship satisfaction), as well as *partner effects* (the effects of the other partner's variable scores;

Table 1 Person-level mediation analyses: Models 1 and 2

Predicted	Marital satisfaction (unmediated model)			PPR (unmediated model)		
	β	SE	Df	B	SE	Df
Intercept	1.26	0.32	54.1	1.92***	0.54	61.5
Gender	−0.41	0.36	31	0.06	0.73	31
Sexual satisfaction						
Actor Sex. Sat.	0.59***	0.08	54.1	0.45***	0.13	61.5
Partner Sex. Sat.	0.23*	0.10	54.1	0.27	0.17	61.5
Gender × actor Sex. Sat.	0.18	0.14	40.3	−0.03	0.22	47.2
Gender × partner Sex. Sat.	−0.10	0.14	40.3	−0.02	0.22	47.2

Gender is coded so that women = 1, men = 0

* $p < .05$; ** $p < .01$; *** $p < .001$

e.g., the partner's sexual satisfaction) on the actor's dependent variable score (e.g., the actor's relationship satisfaction).

Person-Level Analyses

We first conducted mediation analyses using only person-level variables (averaged across the 30 diary days), using a series of three models.

Model 1 predicting marital satisfaction from sexual satisfaction. The following model was used to assess the first step of the mediation:

$$\begin{aligned}
 Y_{ij}(\text{marital satisfaction for person } j \text{ in dyad } i) &= \beta_{0ij} + \beta_{1ij}(\text{gender}) + \beta_{2ij}(\text{actor mean level of sexual satisfaction}) \\
 &+ \beta_{3ij}(\text{actor mean level of sexual satisfaction} * \text{gender}) \\
 &+ \beta_{4ij}(\text{partner mean levels of sexual satisfaction}) \\
 &+ \beta_{5ij}(\text{partner mean levels of sexual satisfaction} * \text{gender}).
 \end{aligned}$$

As can be seen in Table 1, for both men and women, sexual satisfaction predicted marital satisfaction. In addition, the effect of partner's sexual satisfaction was significant for men (i.e., for men, their wives' sexual satisfaction predicted their own marital satisfaction), whereas for women, this partner effect was significant only at trend-level ($\beta = 0.13$, $SE = 0.08$, $df = 54.1$, $p = .09$). This gender difference in the magnitude of the partner effect was not significant.

Model 2 predicting PPR from sexual satisfaction. Using a model similar to the one used in Model 1, actor's PPR was the outcome variable, while gender, actor and partner sexual satisfaction, and the interactions of actor and partner sexual satisfaction with gender were entered as predictors. As can be seen in Table 1, sexual satisfaction significantly predicted PPR for both men and women. The effects of partner's sexual satisfaction on actors' PPR did not reach significance for either men or women.

Model 3 predicting marital satisfaction from sexual satisfaction while controlling for PPR. Using a model similar to the

Table 2 Person-level mediation analyses: Model 3

Predicted	Marital satisfaction (full mediation model)		
	<i>B</i>	SE	Df
Intercept	0.38	0.32	53.5
Gender	−0.49	0.38	29
PPR			
Actor PPR	0.37***	0.09	53.5
Partner PPR	0.09	0.07	53.5
Gender × actor PPR	0.05	0.12	50.9
Gender × partner PPR	−0.02	0.12	50.9
Sexual satisfaction			
Actor Sex. Sat.	0.40***	0.07	53.5
Partner Sex. Sat.	0.09	0.08	53.5
Gender × actor Sex. Sat.	0.17	0.11	50.3
Gender × partner Sex. Sat.	−0.10	0.11	50.3

Gender is coded so that women = 1, men = 0

* $p < .05$; ** $p < .01$; *** $p < .001$

one used in Models 1 and 2, actor's marital satisfaction was the outcome variable, while gender, actor and partner PPR, actor and partner sexual satisfaction, and the interactions of gender with actor and partner PPR (as well as sexual satisfaction) were entered as predictors. As Table 2 shows, for both men and women, their own PPR significantly predicted their own marital satisfaction, even when controlling for sexual satisfaction. For both men and women, the partner's PPR did not significantly predict their own marital satisfaction (i.e., no PPR partner effect).

The final question answered by Model 3 was whether the association between sexual satisfaction and marital satisfaction would be reduced following the inclusion of PPR. The model provided support for partial mediation (see Table 2): Although sexual satisfaction still significantly predicted marital satisfaction when PPR was entered into the model, its effect was significantly smaller in magnitude (Sobel test, $Z = 2.65$, $p = .008$ for men; $Z = 2.33$, $p = .02$ for women). For both men and women, the partner's sexual satisfaction did not significantly predict their own marital satisfaction. Gender did not have a significant effect on the outcome, nor did its interactions with actor or partner PPR or sexual satisfaction.

Given the limitations of the Sobel test, we also followed the recommendations of Ledermann et al. (2011) for assessing mediation with dyadic data, and examined the significance of the indirect effects by calculating bias-corrected 95 % confidence intervals with 10,000 boot-strapped samples. The model in which women and men were treated as distinguishable did not improve the goodness of fit significantly, and, therefore, the more parsimonious model in which they were treated as indistinguishable was used. For both women and men, the confidence interval for the total indirect effect ranged between .10 and .28.

Day-Level Analyses

Next, we conducted mediation analyses using day-level variables as predictors and outcomes, adjusting for person-level means and for lagged (previous day's) outcomes. In the text below, we focus only on the test of the day-level mediation; Tables 3 and 4 report the full results of these analyses (including the lagged and mean-level predictors).

Model 1 predicting daily marital satisfaction from daily sexual satisfaction. The following multilevel models were used to assess the first step of the mediation:

Level 1 equation:

$$Y_{ijk} (\text{marital satisfaction on day } k \text{ for person } j \text{ in dyad } i) \\ = \beta_{0ij} + \beta_{1ij} * (\text{actor's lagged marital satisfaction}[\text{day } k - 1]) \\ + \beta_{2ij} * (\text{actor's sexual satisfaction on day } k) \\ + \beta_{3ij} * (\text{partner's sexual satisfaction on day } k) + r_{ijk}.$$

Level 2 equations:

$$\beta_{0ij} = \gamma_{00} + \gamma_{01} * \text{Gender} + \gamma_{02} * (\text{actor's mean marital satisfaction}) \\ + \gamma_{03} * (\text{actor's mean sexual satisfaction}) \\ + \gamma_{04} * (\text{partner's mean sexual satisfaction}) \\ + \gamma_{05} * (\text{actor's mean marital satisfaction} * \text{Gender}) \\ + \gamma_{06} * (\text{actor's mean sexual satisfaction} * \text{Gender}) \\ + \gamma_{07} * (\text{partner's mean sexual satisfaction} * \text{Gender}) + u_{0i},$$

$$\beta_{1ij} = \gamma_{10} + \gamma_{11} * \text{Gender},$$

$$\beta_{2ij} = \gamma_{20} + \gamma_{21} * \text{Gender},$$

$$\beta_{3ij} = \gamma_{30} + \gamma_{31} * \text{Gender}.$$

As can be seen in Table 3, actors' daily sexual satisfaction significantly predicted their own daily marital satisfaction. The significant gender interaction indicates that the association between sexual and marital satisfaction was stronger for women than for men. Additionally, for both men and women, a significant partner effect emerged: partners' daily sexual satisfaction predicted actors' daily marital satisfaction. Notably, the effects of gender and of (actor and partner) person-mean levels of sexual satisfaction were not significant.

Model 2 predicting daily PPR from daily sexual satisfaction. We used a model similar to the one used in Model 1, with three changes: daily PPR was the outcome variable, and the mean levels of PPR along with the lagged PPR scores replaced mean levels and lagged scores of marital satisfaction as predictors.

As can be seen in Table 3, actors' daily sexual satisfaction significantly predicted their own daily PPR. As indicated by the gender interaction, this actor effect was significantly stronger for women. In addition, as is indicated by the gender by partner PPR interaction, partners' daily sexual satisfaction significantly predicted male actors' (but not female actors') daily PPR. As in Model 1, the effects of gender and of (actor and partner) person-mean levels of sexual satisfaction were not significant.

Table 3 Day-level mediation analyses: Models 1 and 2

	Marital satisfaction			PPR		
	B	SE	Df	B	SE	Df
Intercept	−0.15	0.14	209	−.002	0.04	19.2
Gender	0.14	0.18	207	−0.04	0.05	14.4
Daily sexual satisfaction						
Actor effect	0.36***	0.04	48.2	0.19***	0.03	17.7
Partner effect	0.06*	0.03	67.5	0.12***	0.03	66.3
Gender × actor	0.16***	0.04	1,269	0.14**	0.04	927
Gender × partner	0.01	0.04	577	−0.09*	0.04	712
Mean sexual satisfaction						
Actor effect	−0.02	0.05	209	−0.005	0.01	9.18
Partner effect	0.002	0.04	202	0.001	0.01	10.4
Gender × actor	0.04	0.08	237	0.004	0.02	9.41
Gender × partner	0.01	0.05	237	−0.02	0.01	11.3
Mean marital satisfaction	1.05***	0.07	206			
Mean marital satisfaction × gender	−0.08	0.09	233			
Lagged marital satisfaction	0.01	0.03	60.3			
Lagged marital satisfaction × gender	−0.11**	0.04	1,096			
Mean PPR				1.00***	0.01	17.7
Mean PPR × gender				0.02	0.02	28.4
Lagged PPR				0.07†	0.04	64.5
Lagged PPR × gender				0.06	0.04	1,058

Values from the multilevel models can be interpreted as unstandardized regression coefficients (β coefficients). Gender is coded so that women = 1, men = 0

† $p < .05$ one-tailed; * $p < .05$; ** $p < .01$; *** $p < .001$

Model 3 predicting daily marital satisfaction from daily sexual satisfaction while controlling for daily PPR. We used a model similar to the one used in Models 1 and 2 with daily marital satisfaction as the outcome variable, adjusting for mean levels and lagged scores of marital satisfaction. Actors' and partners' mean levels and day-level PPR as well as sexual satisfaction were entered as predictors, as was gender and its interactions with all predictors in the model.

As can be seen in Table 4, actors' daily PPR significantly predicted their own daily marital satisfaction, even when controlling for daily sexual satisfaction. In contrast, partners' daily PPR did not significantly predict actors' daily marital satisfaction. No significant effects were found for gender, or for mean levels of actors' and partners' PPR in predicting daily marital satisfaction.

The final question answered by Model 3 was whether the association between daily sexual satisfaction and daily marital satisfaction would be reduced following the inclusion of daily PPR. As can be seen in Table 4 (in the fully mediated model), daily sexual satisfaction remained a significant predictor of daily marital satisfaction; however, its effect significantly decreased in magnitude, as indicated by the Sobel test ($Z = 5.39, p < .0001$ for men; $Z = 7.30, p < .001$ for women).

Given the limitations of the Sobel test, we also followed the recommendations of Bauer et al. (2006) and examined the sig-

nificance of the indirect effects by calculating bias-corrected 95 % confidence intervals with 10,000 boot-strapped samples.¹ The confidence interval for the total indirect effect ranged between .03 and .11 for men, and between .11 and .21 for women.

The interaction of gender with daily sexual satisfaction which was significant in Step 1 (the unmediated model), was no longer significant in Model 3. These results provide support for *moderated mediation* (Muller et al., 2005): Gender differences in the association between sexual and marital satisfaction resulted from gender differences in the association between sexual satisfaction and PPR.^{2,3} Similar to the results of Model 2, actor's

¹ The approach suggested by Bauer et al. (2006) essentially involves a simultaneous estimation of Models 2 and 3; in the present case, a model including all covariates as well as all specified actor and partner effects did not converge. As a consequence, the estimates of the mediated effects we report involved a somewhat simplified mediated model in which only actor effects and the moderation of these effects by gender are included. No partner effects emerged in Model 3, and thus no tests of their mediation were conducted.

² To rule out gender differences in the variability of the research variables as an explanation to the gender differences that emerged we checked for differences in both within-person variability (differences in the within-person SDs) and within-group variability (differences in the SDs of the average scores for men or for women). No gender differences emerged.

³ To rule out statistical power as an explanation to the differences between Person-level and Day-level results, all analyses were repeated with 34 df entered for all effects. There were no changes in the results.

Table 4 Day-level mediation analyses: Model 3

	Marital satisfaction (mediated model)		
	β	SE	Df
Intercept	−0.13	0.15	251
Gender	0.17	0.20	234
Mean marital satisfaction	1.04***	0.09	250
Mean marital satisfaction \times gender	−0.05	0.13	286
Lagged marital satisfaction	−0.03	0.03	65.2
Lagged marital satisfaction \times gender	0.11**	0.04	1,067
Daily PPR			
Actor effect	0.41***	0.04	57.9
Partner effect	0.04	0.03	59.5
Gender \times actor	0.06	0.05	844
Gender \times partner	0.08 [†]	0.05	889
Mean PPR			
Actor effect	0.02	0.05	250
Partner effect	−0.02	0.03	263
Gender \times actor	−0.03	0.07	283
Gender \times partner	−0.001	0.06	293
Daily sexual satisfaction			
Actor effect	0.29***	0.04	52.5
Partner effect	−0.001	0.03	62.5
Gender \times actor	0.04	0.04	1,188
Gender \times partner	0.03	0.04	454
Mean sexual satisfaction			
Actor effect	−0.02	0.05	250
Partner effect	0.01	0.04	246
Gender \times actor	0.03	0.08	289
Gender \times partner	0.01	0.05	304

Gender is coded so that women = 1, men = 0

[†] $p < .05$ one-tailed; * $p < .05$; ** $p < .01$; *** $p < .001$

daily PPR significantly predicted daily marital satisfaction for both men and women. The effect of partners' daily sexual satisfaction, which was significant in the unmediated model, was no longer significant in the mediated model. Similarly, the effect of partners' PPR was no longer significant for men, though it was still significant for women. Figure 2 summarizes our results.

Discussion

This study explored the association between sexual and marital satisfaction among newlyweds. It proposed roles for perceived partner responsiveness (PPR) as a mediator and for gender as a moderator of this (mediated) association. The results show that PPR indeed partially mediates the association; in other words, PPR accounts for some (though not all) of the association between sexual and marital satisfaction for both men and women. Importantly, it does so both at the person level and at the daily level. A

second notable finding was the predicted gender moderation of the sexual–marital satisfaction association in the day-level analyses; this association was stronger for women than for men. This day-level gender moderation was due to gender moderation of the association between sexual satisfaction and PPR, which was stronger for women. Moderation did not emerge in the person-level analyses.

As the mediation findings suggest, women and men who are sexually satisfied within their relationship perceive their partners as responsive to them, and this perception (above and beyond the sexual satisfaction itself) is associated with greater marital satisfaction. Additionally, on days in which sexual satisfaction was higher, perceptions of responsiveness were also higher and were associated with increased marital satisfaction. Notably, this latter (day-level) effect was considerably stronger for women than for men. It implies that women may be more reactive to daily fluctuations in sexual satisfaction, a possibility reflected in women's stronger association between sexual satisfaction and PPR. This can be interpreted in line with findings that women, as compared to men, tend to experience sex in a more interpersonal/emotional manner (Birnbaum & Laser-Brandt, 2002; Birnbaum et al., 2006).

The gender moderation effect emerged at the day level alone. Thus, for women (more than for men), daily PPR was tied to fluctuations in sexual satisfaction. At the person level, however, no gender moderation was found. Thus, both women and men who were (on average) more sexually satisfied experienced higher (average) PPR. We find this difference between the day and the person levels intriguing, as it seems to suggest that women's daily PPR is particularly reactive to fluctuations in sexual satisfaction, even though women do not differ from men in the association between the two at a more general (average) level.

Perceived responsiveness from one's partner has been proposed as a central organizing theme for relationship science and as a perception that emerges when relationships are characterized by trust, support, affirmation, and communication (Reis, 2007; Reis & Clark, 2013). Whereas, these non-sexual aspects of relationships have been widely explored, sexual aspects including sexual satisfaction have received little consideration in the growing literature on PPR (though see Birnbaum & Reis, 2012). Our results suggest sexual satisfaction as another route into this perception of responsiveness; indeed, as Birnbaum and Reis (2012) have noted, sex is an important part of close romantic relationships, and a prominent context in which people value responsiveness.

Specifically, finding an association between sexual satisfaction and perceived responsiveness highlights a corporeal aspect of the latter construct, and supports the notion that the gratification of physical needs for connection and pleasure is part of responsive intimate relationships (Hazan & Shaver, 1994). In fact, this physical aspect has gained considerable recognition in the study of early close relationships—namely, those between a parent and an infant.

In the infant literature, multiple models (cf. Beebe & Lachmann, 2002; Feldman, 2012) now highlight how everyday social

behaviors including touch, movement, mutual gazing, and vocalization are dynamically integrated with psychophysiological and affective processes and with hormonal responses to create dyad-specific affiliations. Central to these models is the idea of physical contact and within-dyad synchrony, which (through the mediation of the oxytocin system) facilitates the attachment bond (Feldman, 2012). In adult romantic relationships, interactive behaviors such as affectionate touch, interpersonal focus, and matched dyadic states, which are central components of the reciprocity formed between romantic partners (and of course of satisfying sexual relationships), have also been shown to be mediated by the oxytocinergic system (e.g., Scheele et al., 2013; Schneiderman, Zagoory-Sharon, Leckman, & Feldman, 2012).

Importantly, though sexually satisfying physical contact in adult intimate relationships is likely to operate through many of the same mediators as (non-sexual) physical contact in parent–infant relationships (e.g., Schneiderman et al., 2012), adult contact takes on additional meaning beyond emotional satisfaction and physical pleasure (Waite & Joyner, 2001). First, adult physical contact within committed relationships usually involves a more equitable reciprocity—a dyadic give-and-take. Second, such contact is tied to both partners' sense of esteem for the physical self (Schwartz & Young, 2009; Shackelford, 2001). Third, in long-term adult relationships, physical contact serves as a marker for exclusivity and, therefore, as a barometer for relational safety and stability (though more so for anxiously attached individuals; Butzer & Campbell, 2008; Davis et al., 2006).

To summarize, the extant literature suggests many mechanisms that may play some part in the association between sexual and relationship satisfaction, including psychophysiological synchrony, oxytocin involvement, emotional change, physical pleasure, reciprocity, increased esteem for the physical self, and a stronger sense of security in the relationship. Some of these may themselves be mediated by PPR, in full or in part; but most may also have direct effects on relationship satisfaction. Examining these possible mechanisms and the degree to which they are independent of PPR would reveal more about the processes tying sexual and marital satisfaction.

We focused our work on actor effects—namely, on the association between one's own sexual satisfaction, one's perception of the partner's responsiveness, and one's own marital satisfaction. Because each of these constructs is inherently relational, it was important for us to also take into account partner effects—i.e., the degree to which one partner's sexual satisfaction predicted the other's PPR (or the other's marital satisfaction). In the models testing the unmediated association between sexual and marital satisfaction (i.e., before PPR was included), several partner effects indeed emerged (see Stanik & Bryant, 2012, for similar results). These suggest that the partner's sexual satisfaction may play some role in the actor's marital satisfaction. Importantly, these partner effects were no longer significant in the full models, in which PPR was included as a mediator of the

association between sexual and marital satisfaction. This may be due to the fact that the mediator itself (PPR) involves what is essentially a psychological “partner effect.” Thus, in the full mediation model, once PPR is included, the partner effects disappear.

Limitations and Strengths of the Current Study

In this study, we chose to focus on one possible directional pathway—linking sexual to marital satisfaction through the mediator of perceived responsiveness. In the introduction, we noted the theoretical rationale for this directionality, but also mentioned additional models (e.g., the IEMSS; Lawrence & Byers, 1995) which posit other possible associations (including reverse causation, third-variable explanations, or bidirectionality). To our knowledge, this study is the first to use diary methods to test predictions regarding the association. Our results indeed lent support to the proposed causal direction. Importantly, we see no contradiction between our findings and the possibility of bidirectionality, but this possibility (as well as the other possible association patterns) should be further examined with data of the sort presented here.

Notably, though our findings are supportive of the proposed model, they rely solely on correlational data, and are, therefore, limited in their ability to suggest causality. At the same time, the inclusion of lagged outcomes (e.g., lagged marital satisfaction in the day-level models in which sexual satisfaction predicted current marital satisfaction) helps allay the concern about reverse causation. Specifically, it ensures that whatever variance is explained by our predictor (i.e., sexual satisfaction), is devoid of variance that can be attributed to yesterday's marital satisfaction and its effects on sexual satisfaction or (directly) on today's marital satisfaction.

A second limitation of our study was its use of a relatively small sample, which limits the power of our analyses, especially for the person-level results. This limitation may particularly affect our moderation analyses. However, the gender moderation found in the day-level but not the person-level analysis was not explained by differences in statistical power (see Footnote 3). Relatedly, a strength of the study was its use of mean-centered daily predictors (alongside person-mean predictors). With this approach, daily scores represented deviations from each individual's average levels, and allowed us to rule out static spurious “third variables” as alternative explanations for our findings.

Another limitation was that our sample was largely young, Caucasian, and educated, thus limiting the generalizability of our findings. Additionally, we chose to focus on newlyweds or couples in their first year of marriage. Future studies using samples more varied in ethnicity, education, and socioeconomic status are needed to test whether the findings are relevant to other populations or at other relationship stages. There are some reasons to expect that not to be the case, at least when it comes to the role of sexuality in longer-standing relationships, which seems to be less

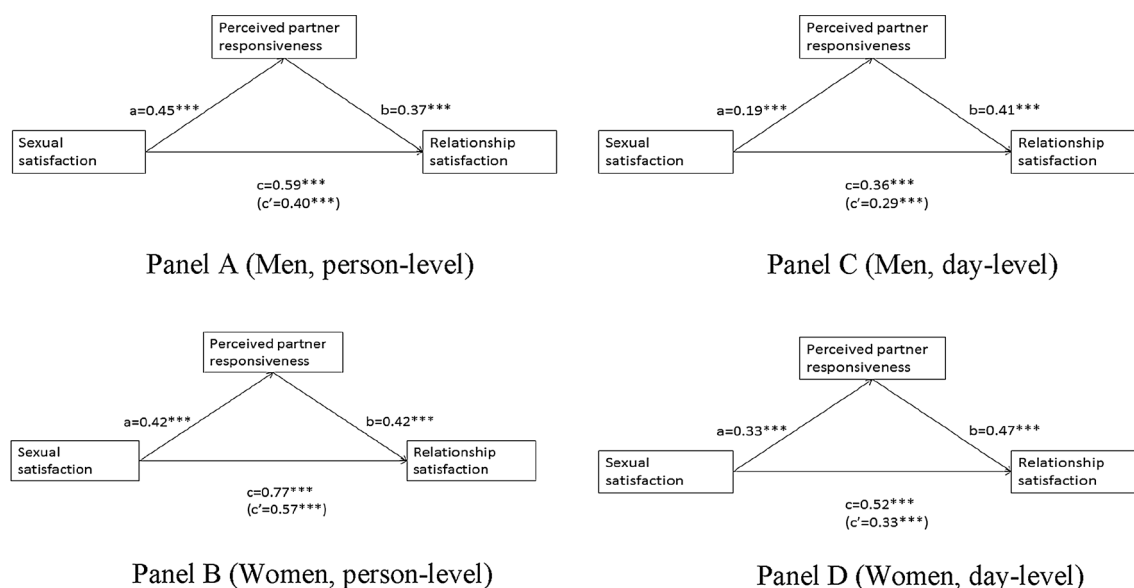


Fig. 2 The obtained results, presented separately for the person-level results and the day-level results, by gender. **a** Men, person-level; **b** women, person-level; **c** men, day-level; **d** women, day-level

central (Heiman et al., 2011). For example, the degree to which the actor's PPR absorbed the partner's sexual satisfaction effects may differ in couples at later relationship stages. Moreover, an older sample may have yielded very different results, as age plays a major part in sexual well-being and distress (e.g., Rosen et al., 2009).

Finally, our study assessed daily sexual satisfaction, with or without actual sexual activity. Indeed, the item used to assess sexual satisfaction may have been somewhat confounded with broader relationship dynamics. It is possible that the effect on marital satisfaction of particularly satisfying or dissatisfying sexual interactions differs from the effect of general sexual satisfaction. Future studies should explore these possibilities with different measures.

Conclusion

To lay observers, it may seem intuitive that the power of sex rests upon its capacities to create intimate connection and foster a deeper sense of knowing the partner. Still, the present study is among the first to evaluate this intuition, and to examine the interplay of sexual and non-sexual factors that contribute to relationship satisfaction. It suggests that the perception of one's partner's responsiveness, found (in previous studies) to result from non-sexual processes such as trust, self-disclosure, and support, also stems from more corporeal sources, such as sexual satisfaction. Theoretically, this places PPR as a proximal precursor to satisfaction, a precursor into which more distal predictors, both sexual and non-sexual, converge. We hope to see additional research testing this, which could help determine how

different individuals might achieve the ultimate outcome of satisfying relationships through different means.

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